The Use of Interactive Technology and Virtual Reality in Support of the Naval Special Warfare Mission

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LONG-TERM GOAL

The long-term goal of this project is to develop and to deploy an interactive computer-based system that enables the creation of user-configurable virtual environments in support of Naval Special Warfare (NSW) planning and rehearsal activities. This next-generation approach to mission planning and rehearsal is based on the use of a Large Scale Virtual Environment (LSVE) that is constructed from observations, model output, analysis products and various data streams. This approach changes the way information is viewed and manipulated, and provides an actual sense of presence to the user thereby aiding in the mental process of assimilating complex mission critical information.

OBJECTIVES

The technological objectives of this effort deal with the specification, design and initial development of a system useful for mission planning and rehearsal for the NSW community, the Virtual Special Warfare Planning System (VSWAPS).

Objective One

This objective will be completed by the submission of a white paper, which will describe in detail the characteristics, capabilities and system design of the target VSWAP system. An analysis of the current NSW mission planning and training procedures will be conducted, followed by the identification of environmental/METOC variables most important to a successful NSW mission planning and training scenario. Based on the results of these first two tasks, we will then design the VSWAPS architecture based on required capabilities emerging from these earlier results.

Objective Two

This objective will be completed by an advanced technology demonstration that highlights the capabilities of the VSWAP system through the use of Virtual Reality (VR) devices at the Center for Coastal Physical Oceanography, Old Dominion University. A specific domain of interest and other

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pertinent demonstration parameters will be chosen by consultation with the Principal Investigators (PI's) and Office of Naval Research (ONR) program managers.

APPROACH

VSWAPS will be designed using the paradigm of Virtual Reality as the fundamental system basis. We will use our experience designing other VR applications as our point of departure for VSWAPS. The functional system will be capable of constructing a navigable, three-dimensional graphical representation of the immediate and adjacent domain of the target area of interest, including visualizations of bathymetry, above-surface images, in-water objects (e.g., mines, bridges), and hydrographic characteristics (e.g., currents, water levels, temperature). The initial information needed to construct the virtual environment will be provided by archived data sets which are downloadable via the Joint Martime Command Onformation System (JMCIS) and/or other standard Navy Command, Control, Communications, Computers, and Intelligence (C4I) protocols. The system will also allow for the integration of additional real-time observations collected by autonomous sensors or swimmer scouts. Furthermore, an ability to rapidly create user-configurable numerical simulations of currents and hydrographic conditions will allow for scenario-based experiments that will play an important role in planning a specific NSW mission.

The application is being designed to perform the following functions:

- Enable initial creation of LSVE dataspace from user defined parameters.
- Perform external data acquisition from archived sources.
- Represent topography/bathymetry with 3D stereo visualizations.
- Integrate typical laydown information (circulation, water properties, levels, and external objects).
- Enable networked user navigation and interaction.

WORK COMPLETED

We have begin work on the white paper deliverable for Objective One. Several discussions have been carried out with NSW personnel regarding curent methods and applications used for mission planning and rehearsal. Demonstrations of our current hardware and software capabilities have been presented to cognizant NSW personnel, and others including the Naval Science Assistance Program (NSAP) Science Advisor, ONR Program Managers and personnel from the United States Navy Office of Special Technology.

In this first year of the project, we have concentrated on designing an application useful for the NSW mission planning/rehearsal phase. The current version of our VR prototyping application, Cave5D, supports much of the functionality required for completion of this project. However, deficiencies in this version are present, especially in the area of placement of irregularly shaped objects within the virtual environment. We are re-architecting Cave5D to ensure that it will ingest and display more generic data in a variety of formats. Irregular objects such as bridges, mine-like objects and moving sensors are now easily visualized from within the virtual environment.

Additionally, the capability for easy inclusion of network-based participants is included. Cave5D has also been linked with the CAVERNSoft programming environment, a C++ hybrid-networking/database

library optimized for the rapid construction of collaborative Virtual Reality applications. We utilize the high performance network connectivity afforded us with our OC3 vBNS connection for regular remote VR sessions with our academic partners. These activities are in readiness for the deliverable of Objective Two, the Advanced Technology Demonstration (ATD). This ATD will be scheduled and its format decided upon after consultation with NSW personnel and ONR Program Managers.

RESULTS

Our discussions with NSW personnel have clearly shown that knowledge of the undersea bathymetry and bottom composition, currents, water levels and water mass distribution in the littoral zone is a tactical necessity for the planning and operational phase of any NSW operation. Operational success for NSW in this brown water littoral operating environment will be hinged upon the ability of force commanders to optimally employ sophisticated combat systems (e.g., NSW SEALs) in highly variable oceanographic conditions. The ability to provide information to both the warfighter and the Joint Task Force (JTF) planning staff regarding the currents, water mass distribution and undersea bathymetry in the form of an interactive, collaborative, graphical 3D Large Scale Virtual Environment will greatly aid in mission/campaign planning and rehearsal efforts.

Our latest version of Cave5D, upon which VSWAPS will be designed around, is a truly configurable, collaborative virtual prototyping application that enables virtual environments to be created from terrain data, numerical model results and environmental observations. Additionally, network-based participants are able to enter the LSVE and interact with each other and the data. This is a significant result.

The image to the left shows a typical view into a collaborative virtual environment created with Cave5D. Oceanographic data has been overlaid upon graphical representations of the bathymetry in the area of interest, in this case the Chesapeake Bay. Each participant in the collaborative session is shown as a circular object or avatar. Although the data shown came from a numerical model, actual observations are easily imported as well. Image courtesy of R. Patterson, NCSA.

IMPACT/APPLICATION

The development activities outlined above are foreunners of our long term goal of enabling the NSW community to utilize an immersive 3D virtual environment for mission planning and rehearsal in a collaborative fashion.

TRANSITIONS

An early version of Cave5D was released to the ocenaographic and scientific visualization community in early 1998. We know of no DoD site utilizing this software yet.

RELATED PROJECTS

We continue our ongoing development of Cave5D with (1) the Electronic Visualization Laboratory (EVL) at the University of Illinois at Chicago to link CAVERNSoft functionality within Cave5D, and (2) with collaborators in the National Computational Science Alliance for further development of the capability for recording, archiving and interaction within the virtual environment.